US009127134B2

(12) **United States Patent**
Byrd et al.

(10) **Patent No.: US 9,127,134 B2**
(45) **Date of Patent: *Sep. 8, 2015**

(54) **METHOD FOR CURING RESIN WITH ULTRASOUND**

(71) Applicant: **The Boeing Company**, Chicago, IL (US)

(72) Inventors: **Norman R. Byrd**, Villa Park, CA (US); **Masood A. Zaidi**, Renton, WA (US); **John A. Petty**, Huntington Beach, CA (US)

(73) Assignee: **THE BOEING COMPANY**, Chicago, IL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 34 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **13/907,048**

(22) Filed: **May 31, 2013**

(65) **Prior Publication Data**

US 2013/0264189 A1 Oct. 10, 2013

Related U.S. Application Data

(60) Division of application No. 13/284,330, filed on Oct. 28, 2011, now Pat. No. 8,540,923, which is a continuation of application No. 12/411,076, filed on Mar. 25, 2009, now Pat. No. 8,048,360.

(51) **Int. Cl.**

C08J 3/28	(2006.01)
B01J 3/00	(2006.01)
B01J 19/10	(2006.01)

(52) **U.S. Cl.**

CPC .. ***C08J 3/28*** (2013.01); ***B01J 3/006*** (2013.01); ***B01J 19/10*** (2013.01); *B29C 2791/006* (2013.01); *B29C 2791/008* (2013.01)

(58) **Field of Classification Search**

CPC B29C 2791/008; B29C 2791/006; C08J 3/28; B01J 3/006; B01J 19/10

USPC 264/443

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,618,599	A	11/1971	Beightol
4,689,244	A	8/1987	Lusk
H465	H	5/1988	Brown
5,009,104	A	4/1991	Johnson
5,634,743	A	6/1997	Chandler
5,888,645	A	3/1999	Lindgaard et al.
6,432,236	B1	8/2002	Leemon et al.
6,511,563	B2	1/2003	Roylance et al.
6,592,799	B1	7/2003	Christensen et al.

(Continued)

FOREIGN PATENT DOCUMENTS

WO	93/15131	8/1993

OTHER PUBLICATIONS

US, Office Action issued Dec. 8, 2010, U.S. Appl. No. 12/411,076.
US, Office Action issued May 11, 2011, U.S. Appl. No. 12/411,076.
US, Notice of Allowance issued Jul. 22, 2011, U.S. Appl. No. 12/411,076.

(Continued)

Primary Examiner — Alison Hindenlang
Assistant Examiner — Robert J Grun
(74) *Attorney, Agent, or Firm* — Gunther Hanke

(57) **ABSTRACT**

A method for curing a resin includes the steps of placing the resin into a reaction vessel, drawing a vacuum in the reaction vessel, positioning the reaction vessel in a gaseous coupling fluid, and applying ultrasonic energy to the coupling fluid.

10 Claims, 2 Drawing Sheets